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INSECTICIDE FORMULAS

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The insecticides listed below are given in the order of their importance in California.

I. HYDROCYANIC ACID GAS

	By weight	By volume
Sodium cyanid (129)	1 oz.	
Sulfuric acid (66° Beaumé, 1.84 sp. gravity)	$2\frac{1}{3}$ oz.	$1\frac{1}{4}$ fluid oz.
Water	2 oz.	2 fluid oz.

Place water and acid in earthenware vessel and add cyanid, or in generating machine dissolve the cyanid in water and then add to the acid, in the proportion of one part of acid to two of cyanid solution.

For house fumigation, use above amounts for 130 cu. ft. (See Circular 127.)

For scale insects on citrus trees, add to distance over the tent one-fifth the number of feet that this measurement is exceeded by the distance around. This gives relative size of the tree; the corresponding dose follows:

10	11	13	15	16	18	20	22	24	26	28	30	32	35	37	40	42
$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5	6	7	8	9	10
44	47	50	53	56	58	61	64			ft.								
12	14	16	18	20	24	28	32	36	40	oz.								

The above is the average dose used in this state; for stronger doses, read one or two places to the right; for weaker, to the left.

Tent leakage more than .25 per cent requires strengthening the dose one space for each .05 per cent.

II. ARSENICALS

These are the cheapest insecticides and should be used whenever available. The following forms are on the market:

	Approximate per cent of metallic arsenic	Relative amount to use
White arsenic	75	1
Paris green	40	2
London purple	30	$2\frac{1}{2}$
Zinc arsenite	25	3
Lead arsenate	10	7
Neutral or basic lead arsenate	8	8

The above can be substituted in the proportion given, except that White arsenic should never be used on foliage, and in the foggy districts along the

coast only the neutral lead arsenate is safe. This material is the only form perfectly safe on stone fruits.

Lime is commonly added at about the rate of 5 pounds to the 100 gallons to Paris green, London purple, and zinc arsenite as a marker, so as to tell whether the spraying is evenly done and as a protection to the foliage, since burning is less liable in the presence of lime.

Spray Formulas

	For orchards	For gardens
(1) Paris green	1⅓–2 lbs.	1 teaspoonfu (¼ oz.)
Lime	6 lbs.	3 teaspoonsful
Water	200 gals.	2 gals.
(2) Neutral lead arsenate	6–12 lbs.	1 tablespoonful (½ oz.)
Water	200 gals.	1 gal.

Dust.—Paris green, London purple, and zinc arsenite are applied as a powder at the rate of 4 to 6 pounds per acre. Apply preferably while plants are moist with dew. Hydrated or air-slaked lime may be added as a marker if desired.

For codling moth and most defoliating insects.

Poisoned Baits

	For fields	For gardens
Bran	10 lbs.	1 pint
White arsenic	½ lb.	½ teaspoonful
Molasses	½ gal.	2 tablespoonsful
Water	2 gals.	½ pint

Mix arsenic and bran dry. Stir molasses and water together and then mix into bran, making a moist paste.

For cutworms and grasshoppers, distribute a handful at base of each vine or tree or it may be broadcasted. Insects will only eat it when moist. When distributed by handfuls it may be gathered up and moistened again.

Ant Poisons

	Strong for native ants	Weak for Argentine ants	
		Large quantity	Small quantity
White arsenic	2 oz.	1 oz.	1 scruple
Sal soda	4 oz.	2 oz.	1 teaspoonful
Sugar	1 lb.	20 lbs.	1 lb.
Water	1 pt.	3 gals.	1 pt.

For native ants, expose a small quantity of the strong poison.

For the Argentine ant, place a sponge in a fruit jar, saturate it with the weak poison, make a few nailholes in the cover and keep jar in pantry and several others in the yard about the house. Add more poison from time to time.

III. LIME SULFUR

This material is sold in California at different densities, which are to be diluted as follows:

32° Beaumé, dilute 1 to 9.
34° Beaumé, dilute 1 to 10.

For San Jose scale or other allied scales on deciduous trees during the dormant season.

For peach moth, apply as the buds are expanding in the spring.

Lime may be added as a marker, as with arsenicals, in which case strain in milk of lime when spray is ready for use.

Home-made lime sulfur may be compounded as follows:

Quicklime	33 lbs.
Sulfur	66 lbs.
Water	50 gals.

Hydrated lime may be substituted for the quicklime, using 44 pounds.

Bring the water to a boil, sift in the sulfur, add the lime and continue to boil for 45 minutes or an hour. It can be strained and used at once or allowed to settle and the clear liquid used, as in the commercial article.

The above amount should be diluted to about 200 gallons. The only safe method to insure the proper strength is to use a hydrometer. This should show about 4° Beaumé when ready to apply.

IV. PETROLEUM OILS

The grades sold for insecticide purposes are:

	Gravity	Approximate flash point
Crude oils—		
Crude oil	18° Beaumé	.....
Crude distillate (heavy)	30	200° F.
Crude distillate (light)	50	60
Asphaltum		
Refined oils—		
Kerosene	42	120
Gasoline	60	32

The density shows the average composition. The smaller the density number the slower the insecticide action and a low flash point indicates the presence of light oils, which increase the penetrating power and therefore the danger when applied to plants. Oils with high flash and high Beaumé number, like kerosene, are considered most desirable, but on account of the cheapness a crude distillate, though a little heavier (with lower Beaumé number), is more extensively used.

Use of Undiluted Oils

Gasoline applied with a brush for woolly aphis on apple. Do not use too much for fear of making dead spots under the bark.

For bedbugs or borers in woodwork.

Sprayed with an atomizer for clothes moths or fleas in carpets. Odor may be disguised by adding 1 per cent of nitrobenzene.

Kerosene may be used the same as gasoline where the greasiness is not objectionable.

For chicken lice and ticks, bedbugs, etc.

For mosquito wrigglers where the cheaper distillate would be objectionable.

Distillate

For chicken lice and ticks when discoloration of buildings would not be objectionable.

Crude Oil and Distillate

Crude oil	18°	4 parts
Distillate	30°	1 part

For mosquito wrigglers, spread in a thin film over surface of infested water. Drainage or other permanent work should have precedence over temporary treatments.

Asphaltum

Make fluid by heating and paint a 6–8 inch strip about the base of the trunk for the peach tree borer.

Distillate Spray

Distillate	10 to 20 gals.
Caustic soda	5 lbs.
Water	200 gals.

To be used only with a power sprayer and only in case it has an efficient agitator. This is necessary to make a mechanical mixture of the oil and water. The lye makes a better spreading and penetration.

For the European fruit scale and similar insects, to be applied only in the dormant season. With kerosene substituted for the distillate it is possible to use as a summer spray for scale insects on citrus trees, though it is rather severe and should not be used except when the tree is well supplied with water and then least susceptible to oil injury.

Miscible Oils

These are also sold under various trade names. They have the appearance of oils, but become milky emulsions upon the addition of water. They are the best form of distillate spray when not prepared to apply the mechanical mixture just described. They have no advantage over the mechanical mixture and are more expensive.

It is generally safe to follow the directions on the container. The emulsifier used is from 20 to 40 per cent of the total volume, therefore use one-quarter to three-quarters more material than when the straight oil is used.

A miscible oil can be made by mixing cresol soap with kerosene, distillate, or crude oil. No rule can be given, but the amount that can be combined with the soap will have to be determined by trial.

Emulsions

These are quite easily made and somewhat safer on foliage than miscible oils, for the reason that ordinary soap has less penetrating power than cresol soap. They are the best forms of oil spray that can be made at home, without the use of a power spray.

	For gardens	For house plants
Soap	½ lb.	1-inch cube
Hot water	1 gal.	1 pint
Kerosene	1 gal.	1 pint

Pump through a spray pump or, with small amounts, use an egg beater. Dilute 1–8 for winter use for scale insects, 1–20 for use on foliage against plant lice.

V. SOAPS

The forms sold for insecticide purposes are fish oil soap, whale oil soap, laundry soap, dog soap, cresol soap, liquid soap, and soap powder. The last three are most convenient for making sprays. Cresol soap is too injurious to foliage to be used except as an emulsifier.

	Summer use	Winter use	Nursery stock dip
Soap	1 lb.	1 lb.	2 lbs.
Water	5–15 gals.	1–2 gals.	1 gal.

Use twice as much of liquid soap because of the water it contains.

For plant lice, home-made soaps can be produced as follows:

	Without rosin	With rosin
Water	6 gals.	25 gals.
Caustic soda	2 lbs.	8 lbs.
Fish oil	1½ gals.	3 pints
Rosin	.....	20 lbs.

Bring the water to boil, dissolve the lye and stir in the oil and rosin, boiling for about an hour.

VI. MINOR INSECTICIDES

Tobacco

The powdered tobacco stems may be dusted generously over the plants for aphids.

A decoction made by steeping one pound of tobacco stems in one gallon of water and diluting to four gallons makes a spray for the same purpose.

The commercial article most used is a 40 per cent nicotine sulphate. A pint makes 200 gallons of spray. It penetrates better if a gallon of cresol soap or 10 pounds of other soap is added.

Pyrethrum

The powdered flowers are used as a dust for fleas.

Sulfur

Sublimed or finely ground sulfur dusted thoroughly over foliage, preferably when moist with dew, for red spiders.

Equal parts of hydrated lime improves the adhesiveness.

Spray with 30 pounds to 200 gallons, with 15 pounds of lime if desired, or better, with 8 pounds of flour made up into cooked paste to spread and hold sulfur on foliage.

Lime

For pear thrips on pear, a whitewash made of 80 pounds to 100 gallons.

Carbon Bisulfid

For grain weevils or other insects affecting stored products.

Place liquid in saucers or other shallow vessels above the material to be treated, using 1 pint to each 100 cubic feet. Time required, one to several hours. If the material to be treated is in a gas-tight space, the liquid may not be all evaporated and that which remains may be saved for later use. The liquid is inflammable and the gas explosive, therefore avoid lights.

For ants, pour an ounce down the hole and close with moist earth.

For ground squirrels, use the same method. (See Circular 82.)

Formalin

For house flies, place a small teaspoonful of the ordinary 40 per cent formaldehyd in a saucer of water or make it up by the bottleful, one part to twenty of water.

Compatibility Table—Insecticides and Fungicides*

		Fungicides			Contact Insecticides					
		Bordeaux	Lime-Sulphur	Iron Sulfid	Cyanid Fumigation	Tobacco	Soaps	Emulsions	Alkalies	Acids
Stomach Poisons (Arsenicals)	Paris Green	A-1	D	A-1	D	?	D	D	D	D
	Calcium Arsenite	A	D	A		A	D	D	D	D
	Lead Arsenate (Acid)	A-1	?	A-1		A	D	D	D	C
	Lead Arsenate (Neutral)	A	B	A		A	A	A	A	D
	Zinc Arsenite	?	D	A-1		A	D	D	D	D
Contact Insecticides	Lime-Sulphur	?	—	—	A	A	C	D	C	C
	Emulsions	?	D	C		A-1	A	—	D	D
	Soaps	A-1 or B	C	C		A	—	—	A	C
	Tobacco	C or D	A	A	A	—	—	—	B	A
	Cyanid Fumigat'n	D	A							
	Acids	D	C	D					C	
	Alkalies	B	C	D						

* Arranged by Geo. P. Gray. For a discussion of the table see Mo. Bull. State Com. Hort., Vol. III, No. 7, p. 265; or *Better Fruit*, Vol. IX, No. 2, p. 9.

CLASSIFICATION OF MIXTURES

Class A1.—Compatible mixtures in which the chief constituents remain practically unchanged but are less liable to decomposition after application or in which an undesirable constituent has been neutralized or rendered less soluble. Mixtures in which the spreading or adhesive qualities are improved are also included in this class.

Class A.—Compatible mixtures in which no important chemical or physical changes occur.

Class B.—Efficient, non-injurious. Mixtures in which important chemical changes occur but the original killing or preventive properties and physical properties are not impaired and no injurious new compound is formed.

Class C.—Inefficient, non-injurious. Mixtures in which important chemical or physical changes occur and render a part or all of the original ingredients inert, or less active, or physically unsuitable for use, but not necessarily injurious to the host of the parasite.

Class D.—Dangerous mixtures. Mixtures in which important chemical changes occur and render all or a part of the original constituents injurious to the host of the parasite. It so happens t hat D stands for dangerous and the table has been so arranged that dangerous mixtures are thus easily recognized by associating the letter which designates the class with the word.

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1904. Twenty-second Report of the Agricultural Experiment Station for 1903–04.
1914. Report of the College of Agriculture and the Agricultural Experiment Station, July, 1913–June, 1914.

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